Survey of vertebrate fauna and habitats in a cypress pine–ironbark forest in Central-West New South Wales

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ABSTRACT

Eighty-two species of vertebrates were recorded from an area of cypress pine and ironbark forest within Goonoo State Forest, located 42 kilometres north-east of Dubbo, New South Wales. Grass-seed-eating birds were uncommon due to the lack of grasses within the forest. Small birds such as fairy-wrens, thornbills and warblers were only found where patches of dense shrub were found, usually where the canopy has been disturbed. Flowering ironbarks were found to attract a variety of bird species utilizing both the pollen and nectar as well as the insects that were attracted. Four threatened species (Glossy Black Cockatoo, Koala, Yellow-bellied Sheathtail Bat, Little Pied Bat) were recorded as well as a new range extension for the Eastern Pygmy Possum. Retention of ironbarks over 47.0 cm diameter at breast height is needed to preserve the presence of large tree hollows as well as eucalypt blossom sources within the forest.

INTRODUCTION

Various vegetation mapping projects by several government departments are underway in the Central-West Region of New South Wales, allowing for broadscale vegetation community delineation. In contrast, fauna survey work in this region has mainly been conducted at individual property level for environmental assessment purposes. Biodiversity surveys by the National Parks and Wildlife Service (NPWS) in North-West New South Wales (Northern Floodplains Planning Region) have focussed on several vegetational communities (e.g., Coolibah/Black Box, River Red Gum, Brigalow) and the State Forests of New South Wales is currently undertaking broadscale fauna surveys within State Forest estates of the north-west and south-west cypress pine–ironbark belt. However, there is currently little known about the fauna inhabiting the cypress pine–ironbark vegetation communities, particularly within the Central-West of New South Wales.

There is a need to know comparative biodiversity levels of the various vegetation communities as well as the remaining extent of each of these communities, if management decisions in regard to future conservation and/or sustainable landuse are to be made. Such knowledge is especially significant with regard to assessments being made on land clearing applications under the current *Native Vegetation Conservation Act 1997* (NVC Act), where priority conservation areas need to be retained as well as the habitats of threatened flora and fauna. Future state vegetation management policies may well be aimed at regional or bioregional levels where ecological information is often lacking.

Cypress pine and ironbark forest communities are one of the major vegetation types within the eastern part of the Central-West Region. Within this area there is some demand for the clearing of cypress pine and for selective logging of both cypress pine and ironbark. The Goonoo State Forest survey site is representative of this vegetation community and thus the results obtained in this study will be comparable to those found in other cypress pine–ironbark communities of similar climate found elsewhere in the Central-West.

The Goonoo State Forest is located in the Pilliga Province of the Northern Sandstones Bioregion as defined by Morgan and Terrey (1992). The Pilliga Province is the most extensive in the Northern Sandstones Bioregion, stretching from Dubbo to Narrabri. Morgan and Terrey (1992, p81) noted that "Although there has been much clearing of the forests and woodlands that originally dominated the sandy soils of this Province, there are large areas of state forest and the more rocky and shallow-soiled areas still carry native forest."

Previous information on the fauna found in Goonoo State Forest is confined mainly to casual sightings of threatened species and from the results of surveys targeting specific species, such as the Glossy Black Cockatoo. Information about the vegetation in Goonoo State Forest is mostly related to millable timber or to the location of threatened flora. This survey will hopefully act as a starting point for the compilation of a comprehensive database for both vegetation and fauna within the forest.

METHODOLOGY

1. *Location*

Goonoo State Forest (area 62 467 ha) is located approximately 42 km north-east of Dubbo, along the Dubbo-Mendooran road (Fig. 1). The survey was undertaken within Compartment 55, which is located on the eastern boundary of the State Forest, at the junction of Freemans Road and Mount Carl Road. The survey area was within the Mogriguy : 50 000 topographic mapsheet (8633 I and IV).

The surveys were undertaken during a six day period in late spring — early summer (28 October–2 November 1996).

2. *Climate*

Climatic data for the survey period was obtained from Dubbo Meterological Station (Table 1). The period was characterized by typical October weather of cool nights and mild to warm days. The only rainfall for the survey period was 0.2 mm recorded on the first day, however, several rainfall events had occurred in the month preceding the survey. Southerly winds were predominant for the first three days with winds slowly increasing in gustiness during this time. A change in wind direction to north-easterlies occurred mid-way through the survey period

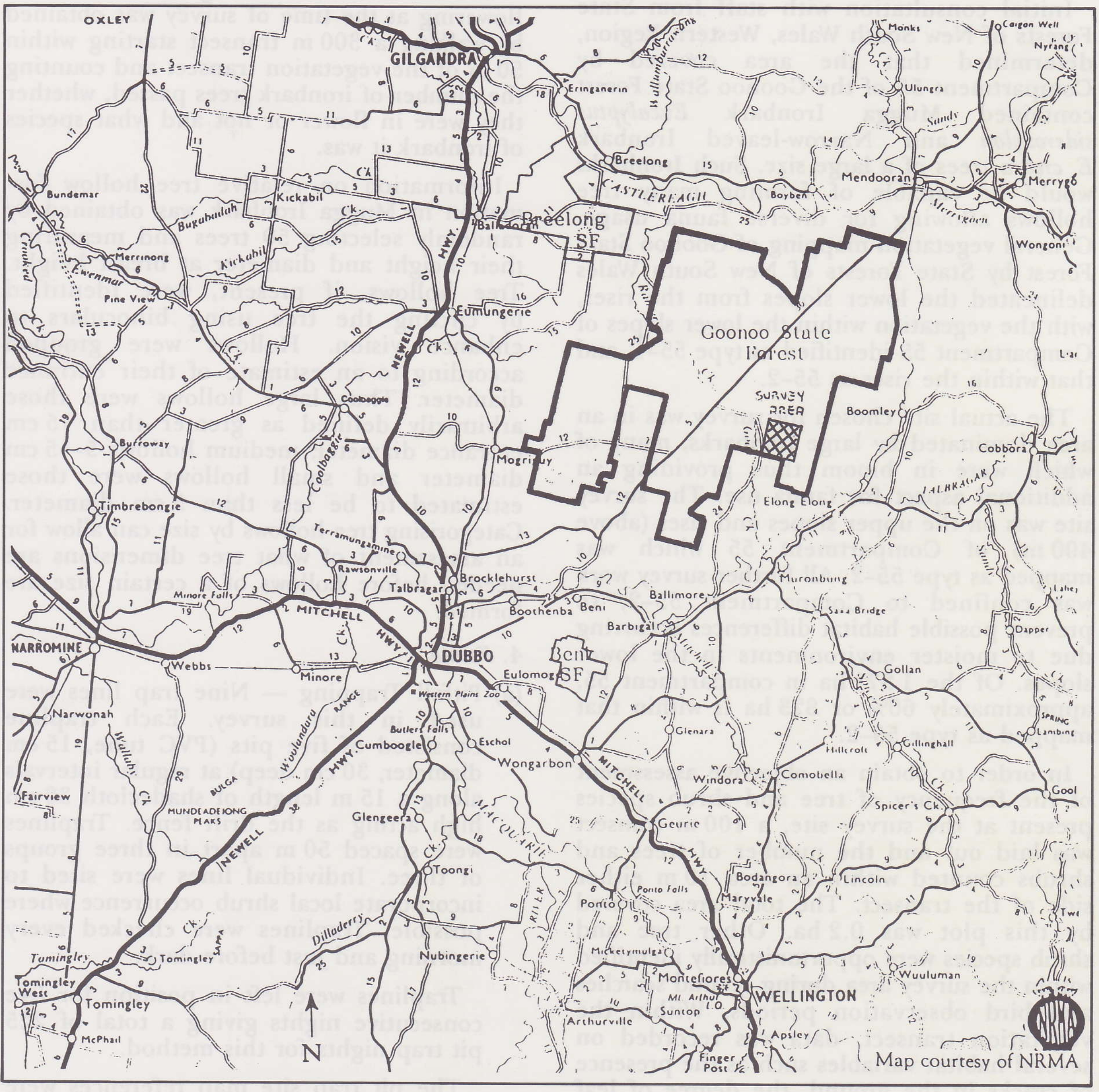


Figure 1. Location of Compartment 55, Goonoo State Forest.

Table 1. Climatic data for the duration of survey period (Dubbo Meteorological Station)

	Temperature (C)			Wind	
Date	Daily Max.	Daily Min.	Rainfall (mm)	Speed (knots)	Direction
28/10/96	25.8	9.9	0.2	3 – 18	SSW
29/10/96	27.6	4.9	0	5 – 20	SSW
30/10/96	23.8	6.3	0	5 – 25	SSW
31/10/96	22.5	6.2	0	6 – 40	ENE
1/11/96	23.2	6.2	0	8 – 35	ENE
2/11/96	26.0	8.4	0	6 – 35	ENE
Av. Monthly (October)	24.3	10.5	48	—	—

Source: State Forests New South Wales, Dubbo District.

bringing with it gusty conditions of up to 40 knots.

3. *Vegetation*

Initial consultation with staff from State Forests of New South Wales, Western Region, determined that the area covered by Compartment 55 of the Goonoo State Forest contained Mugga Ironbark *Eucalyptus sideroxylon* and Narrow-leaved Ironbark *E. crebra* trees of a large size. Such Ironbarks would be capable of forming many tree hollows allowing for diverse fauna usage. General vegetation mapping of Goonoo State Forest by State Forests of New South Wales delineated the lower slopes from the rises, with the vegetation within the lower slopes of Compartment 55 identified as type 55–1, and that within the rises as 55–2.

The actual site chosen for survey was in an area dominated by large ironbarks, many of which were in bloom thus providing an additional aspect for fauna use. The survey site was on the upper slopes and rises (above 400 m) of Compartment 55 which was mapped as type 55–2. All further survey work was confined to Compartment 55–2, to prevent possible habitat differences occurring due to moister environments in the lower slopes. Of the 1 371 ha in compartment 55, approximately 60% or 823 ha is within that mapped as type 55–2.

In order to obtain an objective assessment of the frequency of tree and shrub species present at the survey site, a 100 m transect was laid out and the number of trees and shrubs counted within an area 10 m either side of the transect. The total area covered by this plot was 0.2 ha. Other tree and shrub species were opportunistically identified within the survey area during ground searches and bird observation periods. Within the vegetation transect, data was recorded on several habitat variables such as the presence of cracks in the ground, the degree of leaf litter, the extent of groundcover vegetation, the presence of stones and rocks on the surface and the frequency of fallen logs and timber.

Information on the degree of ironbark flowering at the time of survey was obtained by walking a 300 m transect starting within 50 m of the vegetation transect and counting the number of ironbark trees passed, whether they were in flower or not and what species of ironbark it was.

Information on relative tree hollow formation in Mugga Ironbark was obtained by randomly selecting 50 trees and measuring their height and diameter at breast height. Tree hollows, if present, were identified by circling the tree using binoculars to enhance vision. Hollows were grouped according to an estimate of their entrance diameter. Thus large hollows were those arbitrarily defined as greater than 15 cm entrance diameter, medium hollows 5–15 cm diameter and small hollows were those estimated to be less than 5 cm diameter. Categorising tree hollows by size can allow for an assessment of what tree dimensions are needed before hollows of a certain size are formed.

4. *Fauna*

(a) Pitfall Trapping — Nine trap lines were used in this survey. Each trapline consisted of five pits (PVC tube, 15 cm diameter, 30 cm deep) at regular intervals along a 15 m length of shadecloth 30 cm high acting as the drift fence. Traplines were spaced 50 m apart in three groups of three. Individual lines were sited to incorporate local shrub occurrence where possible. Traplines were checked every morning and just before dark.

Traplines were left in position for five consecutive nights giving a total of 225 pit trap nights for this method.

The pit trap site map references were centred on 687500 E, 6450800 N.

(b) Small Mammal Trapping — Twenty Elliott Type "A" small mammal traps were used with two being placed within 30 m of each pitfall line. Another two traps were positioned in a previously logged area that contained a number of fallen logs. Traps were placed in clumps of shrubs and in hollow logs. Each trap was baited with peanut butter and rolled oats.

Traps were left in position for five consecutive nights giving a total of 100 trap-nights.

(c) Bats — A mist net was set out for three consecutive nights at three different locations within the survey area. The net was positioned across a forestry track on two occasions as this was noted as being utilized by bats as a flyway, and for one night alongside a pool of water left after rain several days previous to the survey period. One night's trapping with a harp trap was also conducted at the pool.

An Anabat II bat call detector was utilized for two nights after the initial survey period (3–4 December) when the equipment became available. Calls were recorded for one night at the trapping site and another night adjacent to a dam on the northern boundary of compartment 55.

(d) Bird Observations — Incidental observations were recorded during the checking of all traps each morning. A minimum of two hours were spent walking through the survey area each morning and again each afternoon with special emphasis being given to areas of flowering ironbarks. Observations were made with the aid of 10 × 30 power binoculars.

(e) Ground Searches — A minimum of one hour per day was used in turning over fallen logs, shed bark, stones and rocks in searches for reptiles. Ground searches were also made opportunistically during the bird survey periods.

(f) Vocalization Playbacks and Call Recording — Playbacks of the calls of the Masked, Sooty and Powerful Owls as well as the Koala were conducted through two 30 watt speakers for five nights at two locations around the survey area. Different locations were used each night. Locations were chosen randomly as the survey area was of a similar vegetation type. A five minute period of listening for replies was spaced between each call sequence.

Frog calls heard from pools of water were recorded and later identified from comparison with a frog call identification tape (Barker and Grigg 1983).

(g) Spotlighting — An attempt to observe nocturnal fauna was made by spotlighting from a slow moving vehicle along the forestry tracks bordering the compartment under survey.

Torchlight searches of areas of known ironbarks in flower away from the tracks were made in an attempt to observe possum or glider species. Spotlighting was conducted for two hours each night over three nights.

RESULTS

1. *Logging History of Compartment 55*

Information supplied by State Forests Dubbo District (Ross Irvine, pers. comm.) indicates that the Compartment may have been logged initially in the 1930s and again in the 1960s before any detailed compartmental harvest records were kept. Since records have been kept the ironbarks in Compartment 55 were logged for sleepers 7–8 years ago. Logging of cypress pine in the Compartment was assumed not to have taken place. The majority of pine in the area is Black Cypress Pine *Callitris endlicheri* which currently has little to no market value.

Regular hazard reduction burns have been carried out within the State Forest but this management practice has been discontinued for at least ten years.

2. *Vegetation*

Vegetation characteristics of the survey site were obtained via a transect count of all tree and shrub species over a 100 m × 20 m area. Groundcover species were not identified. Total tree and shrub density was found to be 1825 stems/ha. Tree saplings were included in the count as trees. The floristic list by frequency of occurrence is given in Table 2.

Within the surveyed plot there were no cracks in the soil surface, nor were there any rocks or stones. However, small scattered rock outcrops were noted at other sites within Compartment 55–2. At the survey area a layer of stones was often encountered at about 25 cm depth when putting in pit traps. It was noted at the time that water was being trapped above this layer in the soil in several pits but was not present on the surface. Leaf litter was assessed as covering 40–75% of the ground surface depending on location. Groundcover plants were assessed as covering approximately 5% of the surface. Within the Compartment there were many dead shrubs

Table 2. Frequency of occurrence of trees and shrubs from survey site transect, Goonoo State Forest, Compartment 55–2.

Species	% of Occurrence
Upper Storey:	
Eucalyptus **sp. — ironbarks (*E. crebra, E. sideroxylon, E. fibrosa*)**	4.2%
Callitris endlicheri (Black Cypress Pine)	3.4%
Eucalyptus viridis (Green Mallee)	<1%
Eucalyptus dealbata (Tumbledown Red Gum)	<1%
Middle and Lower Storey:	
Calytrix tetragona (Fringe-myrtle)	26.9%
Acacia sp. (*A. buxifolia, A. hakeoides, A. deanei*)	13.2%
Melaleuca uncinata (Broombush)	12.3%
Acacia triptera (Spur-wing Wattle)	11.4%
Hibbertia sericea (Silky Guinea Flower)	10.5%
Dillwynia junipera (Prickly Parrot Pea)	6.7%
Allocasuarina gymnanthera	6.2%
Allocasuarina diminuta	1.9%
Macrozamia communis (Burrawang)	<1%
Xanthorrhoea australis (Grass Tree)	<1%
Melichris uceolatus (Urn Heath)	<1%
Micromyrtus ciliata (Heath-myrtle)	<1%

and small trees, possibly from windstorm damage as most were on the ground. Several areas also had dead clumps of Spur Wing Wattle which were decomposing and these areas also tended to have a higher density of live shrubs. An average of one fallen log per 50 m of transect was noted for the area from several transects around the pitfall trap sites.

Over the course of the survey, several other vegetation species were noted as present in Compartment 55–2. These species were added to the above representative frequency list to provide a fuller account of the floristics present. The full list of identified species for the survey area is given in Table 3.

One of the habitat variables that was investigated prior to site selection was the presence of flowering eucalypts. Large amounts of blossom in an area will enhance its habitat value to nectivorous fauna such as honeyeaters, possums and gliders and therefore enhance the chances of observation. In the area where the pit traps were located a 300 m transect was walked and all flowering ironbarks were counted. Of a total of 106 ironbarks, 46 (43%) were observed to be in flower. All of these were Mugga Ironbark. Narrow-leaved Ironbark was found to represent approximately 10% of the remaining trees not in flower, thus slightly less than half the Mugga Ironbark present was in bloom at the time of survey. Another habitat element with value for nectivorous fauna, the presence of mistletoe, in this case Box Mistletoe *Amyena miquellii*, was noted on less than 5% of all ironbarks throughout the transect, and usually at a density of only one plant per tree. No mistletoe was noted on other vegetation along the transect. Mistletoe is a food resource for several honeyeater species and its presence could also enhance a sites potential for supporting fauna. Although mistletoe is found at low frequency in the Compartment, the large number of trees overall means that there are sufficient plants present for utilization by fauna.

In order to assess the habitat value of the survey area to arboreal fauna, a small-scale survey of tree hollow frequency was

Table 3. Vegetation list for cypress pine–ironbark forest survey site, Goonoo State Forest Compartment 55–2.

Callitris endlicheri (Black Cypress Pine)
Eucalyptus sideroxylon (Mugga Ironbark)
Eucalyptus crebra (Narrow-leaved Ironbark)
Eucalyptus fibrosa (Broad-leaved Ironbark)
Eucalyptus viridis (Green Mallee)
Eucalyptus dealbata (Tumbledown Red Gum)
Allocasuarina gymnanthera (She-oak)
Allocasuarina diminuta (She-oak)
Melaleuca uncinata (Broombush)
Melaleuca thymifolia
Hakea decurrens
Acacia triptera (Spur Wing Wattle)
Acacia deanei ssp. *paucijuga* (Deanes Wattle)
Acacia hakeoides (Western Black Wattle)
Acacia buxifolia (Box-leaf Wattle)
Exocarpus cupressiformis (Cherry Ballart)
Macrozamia communis (Burrawang)
Xanthorrhoea australis (Grass Tree)
Isopogon petiolaris (Drumstick)
Melichris uceolatus (Urn Heath)
Dillwynia juniperina (Prickly Parrot Pea)
Calytrix tetragona (Common Fringe-myrtle)
Micromyrtus ciliata (Heath-myrtle)
Dampiera lanceolata (Grooved Dampiera)
Helichrysum bracteatum (Golden Everlasting)
Grevillea anethifolia (Spiny Cream Spider-flower)
Cheileanthes tenuifolia ssp. *tenuifolia* (Rock Fern)
Hibbertia serica (Silky Guinea Flower)
Dianella revoluta (Spreading Flax-lily)
Lepidosperma laterale (Variable Sword-sedge)
Pterostylis rufa (Ruddy Hood Orchid)
Amyena mitchellii (Box Mistletoe)

conducted. Fifty Mugga Ironbarks were measured for height and diameter at breast height and then examined visually for tree hollows. Tree selection was aimed to cover the range of tree sizes present in the survey area. A summary of the results is shown in Table 4.

This gives an indication of the size of cypress pine used by fauna as nesting habitat.

Despite the small sample size, data in Table 5 suggest that there is no relation between cypress pine tree size and their potential for nest utilization.

Table 4. Tree hollow information — Mugga Ironbark *Eucalyptus sideroxylon*.

	Mean No. Hollows / Tree				Tree Height (m)	
D.B.H. (cm)	Small	Medium	Large	Total	Mean + SD	Range
0 – 19	—	—	—	—	8.4 + 1.0	7 – 10
20 – 29	0.25	—	—	0.25	11.4 + 2.7	8 – 14.5
30 – 39	0.14	—	—	0.14	11.6 + 1.6	10 – 14
40 – 49	0.79	0.64	0.14	1.57	12.7 + 1.4	10 – 14.5
50 – 59	2.10	1.50	0.42	4.02	14.5 + 1.4	11 – 16
60 – 69	1.17	1.50	0.67	3.34	14.8 + 1.1	13.5 – 16
70 – 79	3.00	2.00	1.00	6.00	15	—
>80	1.00	3.00	1.00	5.00	15.5	—

D.B.H. = Diameter at Breast Height
Tree Hollow Size Classes — Small (0–5cm), Medium (5–15cm), Large (>15cm)

Most tree hollows were noted to occur where side limbs had fallen or broken off. Occasional hollows were noted on the main trunk of large trees. From the data in Table 4 it can be seen that trees up to 12 m in height generally had few hollows, or if they did they were small in size. These trees were noted to be mostly a straight trunk growing into the canopy without any secondary limb development. The correlation co-efficient (r) between tree height and the total number of hollows was 0.58. However, of more importance to hollow formation is tree girth (r = 0.70) where a diameter at breast height of 43.0 cm was needed before even small hollows were consistently noted. Large tree hollows were only observed in trees with a diameter at breast height of 47.0 cm or greater, usually in conjunction with several other hollows of smaller size.

Similar data for cypress pine was not gathered as no cypress with hollows were noted. However, the tree height and diameter were measured for ten cypress pine which were found to contain bird nests (Table 5).

Table 5. Dimensions of Cypress Pine trees containing bird nests.

Tree Height (m)	Diameter at Breast Height. (cm)
11.2	15.9
10.5	15.9
10	16.2
10	13.7
9.5	14.3
8	14.6
8	12.7
8	9.6
5.5	8.0
5.5	8.0

3. *Fauna*

A total of eighty-two fauna species were recorded as present in Compartment 55-2 of Goonoo State Forest over the six days of survey. The nine species of reptiles, four amphibians, 18 mammals and 51 birds are listed in Table 6.

Table 6. Fauna list for cypress pine–ironbark forest, Goonoo State Forest Compartment 55–2.

Species
Amphibians
Crinia signifera (Brown Froglet)
Litoria latopalmata (Broad-palmed Frog)
Litoria peronii (Peron's Tree Frog)
Lymnodynastes ornatus (Ornate Burrowing Frog)
Reptiles
Diplodactylus vittatus (Stone Gecko)
Heteronotia binoei (Prickly Gecko)
Pogona barbata (Eastern Bearded Dragon)
Amphibolurus muricatus (Jacky Lizard)
Ctenotus allotropis (Ctenotus Skink)
Menetia greyii (Dwarf Skink)
Lerista bouganvillii (South-eastern Slider)
Lerista muelleri (Wood Mulch Slider)
Pygopus lepidopodus (Common Scaly-foot)
Mammals
Macropus giganteus (Eastern Grey Kangaroo)
Macropus rufogriseus (Red-necked Wallaby)
Wallabia bicolor (Swamp Wallaby)
Cercartetus nanus (Eastern Pygmy-possum)
Phascolarctos cinereus (Koala)
Tachyglossus aculeatus (Echidna)
Chalinolobus gouldii (Gould's Wattled Bat)
Chalinolobus morio (Chocolate Wattled Bat)
Chalinolobus picatus (Little Pied Bat)
Saccolaimus flaviventris (Yellow-bellied Sheathtail Bat)
Mormopterus planiceps [large penis form] (Southern Freetail Bat)
Scotorepens balstoni (Western Broad-nosed Bat)
Vespedelus vulturnis (Little Forest Bat)
Nyctinomus australis (White-striped Freetail-bat)
Nyctophilus sp. (Long-eared Bat)

Table 6 — *continued*

Species
Mammals — *continued*
Vulpes vulpes (Fox)
Felis catus (Feral Cat)
Oryctolagus cuniculus (Rabbit)
Birds
Dromaius novaehollandiae (Emu)
Falco subniger (Black Falcon)
Turnix varia (Painted Button-quail)
Phaps chalcoptera (Common Bronzewing)
Calyptorhynchus lathami (Glossy Black Cockatoo)
Cacatua roseicapilla (Galah)
Platycercus eximius (Eastern Rosella), nesting
Barnardius barnardi (Mallee Ringneck)
Cuculus pallidus (Pallid Cuckoo)
Cuculus flabelliformis (Fan-tailed Cuckoo)
Podargus strigoides (Tawny Frogmouth)
Ninox novaeseelandiae (Southern Boobook)
Caprimulgus mystacalis (White-throated Nightjar)
Dacelo novaeguineae (Laughing Kookaburra)
Todirhampus (Halcyon) sancta (Sacred Kingfisher)
Apus pacificus (Fork-tailed Swift)
Merops ornatus (Rainbow Bee-eater)
Coracina novaehollandiae (Black-faced Cuckoo-shrike), nesting
Petroica goodenovii (Red-capped Robin)
Eopsaltria australis (Eastern Yellow Robin)
Microeca leucophaea (Jacky Winter)
Pachycephala rufiventris (Rufous Whistler)
Colluricincla harmonica (Grey Shrike-thrush)
Myiagra inquieta (Restless Flycatcher)
Rhipidura fuliginosa (Grey Fantail)
Pomatostomus temporalis (Grey-crowned Babbler)
Pomatostomus superciliosus (White-browed Babbler), nesting
Malurus cyaneus (Superb Fairy-wren)
Sericornis sagittatus (Speckled Warbler)
Acanthiza uropygialis (Chestnut-rumped Thornbill)
Acanthiza chrysorrhoa (Yellow-rumped Thornbill)
Cormobates leucophaea (White-throated Treecreeper)
Anthochaera carunculata (Red Wattlebird)
Acanthagenys rufogularis (Spiny-cheeked Honeyeater)
Philemon corniculatus (Noisy Friarbird), nesting
Manorina melanocephala (Noisy Miner)
Lichenostomus virescens (Singing Honeyeater)
Lichenostomus leucotis (White-eared Honeyeater)
Lichenostomus fuscus (Fuscous Honeyeater)
Lichenostomus penicillatus (White-plumed Honeyeater)
Melithreptus brevirostris (Brown-headed Honeyeater)
Acanthorhynchus tenuirostris (Eastern Spinebill)
Pardalotus punctatus (Spotted Pardalote)
Pardalotus striatus (Striated Pardalote)
Zosterops lateralis (Silvereye)
Corcorax melanorhamphos (White-winged Chough)
Grallina cyanoleuca (Australian Magpie-lark)
Cracticus torquatus (Grey Butcherbird)
Gymnorhina tibicen (Australian Magpie)
Strepera graculina (Pied Currawong)
Corvus coronoides (Australian Raven)

The majority of fauna species were recorded from observation and ground searches rather than by trapping. No animals were caught in the Elliott small mammal traps. Of the 225 pit trap nights available from the pitfall traps, eleven animals of five species were caught (Eastern Pygmy Possum (5), Common Scaly-foot (2), Stone Gecko (2), *Lerista muelleri* — lizard (1), *Ctenotus allotropis* — lizard (1)). Of these five species, only the latter two were found in subsequent groundsearches of the survey area. This indicates the value of incorporating differing methods of fauna survey.

A mist net was set for three consecutive nights at differing locations resulting in the capture of a single Gould's Wattled Bat *Chalinolobus gouldii* even though bats were observed to be flying frequently on the first night. A cool change greatly lessened bat activity on the following two netting nights which made the chances of capture even more remote. Moderate to strong gusty winds prevented any further nights of net use (see Table 1). A further capture of a Gould's Wattled Bat was made in the one night of harp trapping.

Analysis of the bat call recordings made using the Anabat detector showed the presence of nine species of bats (Table 6). Calls of a long-eared bat were recorded but analysis of the *Nyctophilus* genus are difficult to attribute to a species (G. Hoye, pers. comm.). With three species' distributions within the general region, identification was left at the genus level. Six bat species were recorded from the pitfall trapping site when the Anabat detector was connected to a delay-switch and left overnight. Four of these species were also recorded from a second nights detection at a dam on the boundary of Compartment 55. The Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* and the Chocolate Wattled Bat *Chalinolobus morio* were recorded only at the pitfall site, while the White-striped Freetail Bat *Nyctinomus australis*, Southern Freetail Bat *Mormopterus planiceps* and the Western Broad-nosed Bat *Scotorepens balstoni* were only recorded at the dam.

The abundance of bats in the survey area most likely reflected the combination of the availability of tree hollows on the mature ironbarks and the high density of insect presence associated with eucalypt blossum. A survey of a logged Compartment similarly vegetated to that of Compartment 55–2 would give a useful indication of bat species tree hollow requirements.

An unexpected result was that spotlighting also failed to reveal any arboreal species with the exception of a Koala being heard growling some distance into the forest near the boundary with Compartment 80. Playback calls of the Powerful, Masked and Sooty Owls brought no response except from several Tawny Frogmouths. Calls recorded before playback commenced were identified as a Southern Boobook and a White-throated Nightjar.

Four bird species were found nesting at the time of survey with one nest each of the Eastern Rosella, Black-faced Cuckoo-shrike, and Noisy Friarbird being located in mature ironbark trees. One nest of the White-browed Babbler was located in a cypress pine. Another species, the Mallee Ringneck was probably nesting as a pair was heard calling constantly and the female had worn and ruffled tail feathers indicating she may have been on a nest.

The trapping of five Eastern Pygmy Possums represents a new range extension for this species. This species has not previously been noted by State Forest personnel at Goonoo and the National Parks and Wildlife Service database had the closest report of this species at Parkes. The capture of two males, two females and one juvenile over an area of several hundred metres indicates that there could be a sizeable breeding population of this cryptic species present.

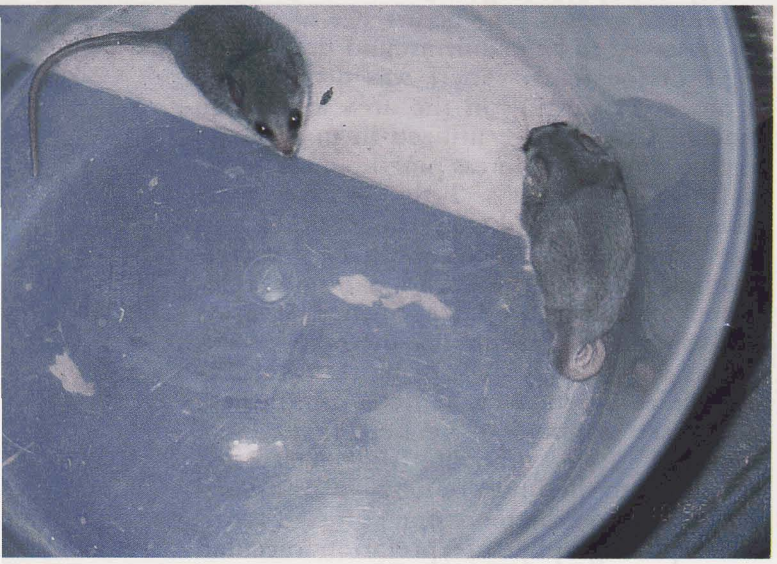
Four species, the Koala *Phascolarctos cinereus*, Glossy Black Cockatoo *Calyptorhynchus lathami*, Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* and the Little Pied Bat *Chalinolobus picatus* are listed as vulnerable species in the *Threatened Species Conservation Act 1995*. All threatened species sightings in Goonoo State Forest are recorded by the State Forest Dubbo District so that areas of utilized habitat can be retained and where possible excluded from forestry operations. A single Koala was heard grunting one night near the boundary with Compartment 80 while two Glossy Black Cockatoos were observed flying over the Compartment late one afternoon and another fourteen were observed in a mature ironbark near the boundary with Compartment 54. Analysis of the sonic calls of bats revealed the presence of both the Yellow-bellied Sheathtail Bat and the Little Pied Bat at a dam on the boundary of the survey compartment. The Little Pied Bat was also recorded at the trapping sites, some 3.5 km south of the dam.

DISCUSSION

This survey was not intended to provide a comprehensive list of the flora and fauna present in the Goonoo State Forest. The intention was to survey the vertebrate fauna of an area representative of cypress pine-ironbark forest, a vegetation formation that covers significant portions of the central division of New South Wales. With this in mind, the recording of eighty-two species can only be taken as part of the fauna present in the forest as a whole. Heron (1973) listed 110 bird species recorded by several ornithologists from one site in the south-west corner of Goonoo State Forest over several years. The present survey recorded 51 bird species. Part of the reason for the differences in species diversity is that several vegetation communities present in Goonoo State Forest were not surveyed. Other communities that could be assumed to have their own distinct faunal assemblages within Goonoo State Forest are the River Red Gum forest along the creeks and drainage channels, Green Mallee woodland, and, within the lower elevation portions of the Forest, stands of Tumbledown Red Gum and Dwyers Red Gum mixed with the cypress pine and ironbark.

State Forests New South Wales has recently commissioned a fauna survey of the forestry estate throughout the north-west cypress–ironbark belt of New South Wales (Date and Paull 1996). It would have been valuable to compare this with the results of the present survey to see whether there are any new records for the Goonoo State Forest or for the specific habitat surveyed here. Unfortunately, Date and Paull (1996) did not report fauna records by actual location, instead listing them by broad vegetation community or by forestry district where they were recorded. Species that were recorded from vegetation communities similar to the chosen site in Goonoo State Forest could not be extracted for comparison. Utilizing species recorded in the Dubbo Forestry District alone would encompass many different habitats that were not covered by this survey thus negating direct habitat comparisons.

Within Compartment 55 only the higher elevation areas were surveyed in any detail. Several observations can be made from the survey results. Firstly, the survey area within the Compartment was characterized by a very low percentage cover of native or introduced grasses. The occurrence of grasses was observed to be mainly around the outside edges of the forest. There was no evidence of any stock grazing in the area which is a management practice utilized in many State Forests. Therefore cypress pine-ironbark forest in this locality has little to no grass groundcover. That being the case, it was then expected that there would be a corresponding lack of grass seed eating species in the ensuing survey. No finches or grass parrots were observed and of the other parrot species only a single pair of Eastern Rosellas and Mallee Ringnecks were noted. Both these pairs were assumed to be nesting in large ironbarks. It is probable that the birds travelled into the forest to nest but continued to feed away on the more open grassed areas. Aerial photography interpretation revealed



Above left: Pit trap lines were situated to take advantage of any shrub layer as well as being among mature ironbark.

Left centre: The Eastern Pygmy Possum was trapped at sites where cypress pine was the dominant tree species as well as at sites having a majority of ironbark.

Below left: All Eastern Pygmy Possums were captured in pitfall traps. No sightings were made by spotlight survey in the same area.

Above right: Typical of vegetation surveyed with mature Mugga Ironbark and more abundant but smaller diameter Black Cypress Pine.

Right centre: The semi-cleared area on the right is indicative of a disused site for bee hives. Vegetation on the left is more representative of the natural forest formation.

that the nearest significant areas of habitat with a grassland component are located approximately five kilometres south-west and three kilometres east of the survey site. Several pairs of Galahs were also noted in the forest but did not seem to remain permanently in the area perhaps indicating that the area is only a part of their home range. The only parrot species assumed to remain permanently within the confines of genuine cypress pine-ironbark forest was the Glossy Black Cockatoo which feeds primarily on the cones of *Casuarina* species and not on grass seeds. A sizeable resident population of this cockatoo is known to inhabit the area.

Shrub cover was generally consistent throughout the survey area, but occasionally occurred in dense patches where disturbance had removed some canopy trees. It was in these dense shrub patches where the majority of fairy-wrens, thornbills, silvereyes and warblers were found. Otherwise these species were encountered at very low densities. Disturbance of the tree canopy was mainly found to have been caused by wind storm damage. Old logging dump patches and areas of previous bee hive locations utilized by apiarists operating in the State Forest were also noted as sites of vegetation disturbance. At the low levels of disturbance found in Goonoo State Forest, the act of opening up the canopy has actually benefited overall faunal diversity of the area. Similar effects may occur during the harvesting of cypress pine provided that selective thinning was used rather than complete logging of large areas. Initial observations suggest that some bird species nest in cypress pines of differing ages (see height and diameter measurements in Table 5) and that cypress pines generally do not form tree hollows that would be utilized by arboreal mammals. The height of the bird nests from the ground may be a more important factor than the height of the tree, especially as the species utilizing the nests are unknown. Unfortunately these data were not taken at the time of survey. From a forestry management point of view, it is possible to manipulate a stand of cypress pine to provide trees of a certain height/diameter within the constraints of the site and age of the stand, since cypress pine height and diameter growth are dependent on tree density (S. Cottier, pers. comm.).

Thus sensible harvesting of cypress pine may not negatively impact on all local forest fauna and may even increase local biodiversity by opening up the canopy and increasing grass and shrub density in selected areas (Wells 1974). The thinning of cypress pine stands when young acts to prevent stand lock-up, where dense growth of small trees will remain at that level due to the high competition for water and nutrients. Thinning of dense regeneration encourages growth in the remaining trees (Horne and Robinson 1987). The thinning of cypress pine stands when locked up for extended periods (>100 years) has an effect of increasing vegetation but does not give rapid growth of cypress pine trees and hence may still limit the stand's value for arboreal species use via the lack of a mature tree component (Anon. 1988). Mature cypress pine will generate a higher seed load (a food resource for fauna) and may provide tree hollows although cypress is not noted as a hollow-bearing species. Consultation with State Forests revealed that in situations where arboreal species are to be positively affected then it may be necessary to almost remove the cypress stand to allow other tree species to dominate while a new cypress stand develops that can be managed (S. Cottier, pers. comm.). It must be stressed however that these suggestions would need to be further qualified by a research programme. For example, the thinning of cypress pine may impact on the Eastern Pygmy-possum which is known to utilize abandoned bird nests as well as tree hollows. The Koala is also noted to utilize cypress pine but it is unknown whether it is for a supplementary food source, as a form of heat abatement strategy (pines give more shade) or as stopovers in the animal's movement between localities.

Preliminary data gathered on tree hollow development in ironbarks suggested that only mature trees greater than 47.0 cm diameter at breast height develop large tree hollows. Thus logging of the ironbark resource would need to be conducted so as to retain a proportion of trees of this class within each Compartment, otherwise a lessening of the habitat value of the area will occur. The degree of retention of mature ironbarks needed to provide sufficient hollow resources for fauna would need to be ascertained by further research.

Another factor limiting the number of species recorded was the lack of permanent water sources thus ruling out the presence of any waterbirds and several amphibian species. The four amphibian species noted in this survey were found in temporary rainwater pools resulting from storms the week before. Three species were noted again in a permanent dam at the boundary of Compartments 55 and 54. Only one species of burrowing frog was recorded, perhaps because others would have already been active after several rainfall events in the weeks prior to survey.

A significant percentage of bird species detected were nectivorous. This was no doubt because the survey coincided with the flowering of Mugga Ironbark. While there were large numbers of birds seen in the forest at all times, the majority of them represented few species. Flocks of differing species would occupy certain areas at differing times throughout the survey period. The dominant species at the start of the survey was the White-plumed Honeyeater which was completely replaced towards the end of the survey by the White-eared Honeyeater and the Noisy Friarbird. All other nectivorous species present were at much lower density than those above. The survey also coincided with the annual migration of the Bogong Moth through the area thus insectivorous species were also well represented. The Pied Currawong was observed many times to be stripping loose bark off trees, particularly red gums, in their hunt for insects. They were also observed to fly into the flowering canopy of the ironbarks with wings outstretched in order to dislodge moths which they subsequently chased.

Compartment 55-2 contains a representative example of the cypress pine-ironbark forests of the region. However, before a complete picture of the fauna present in such a habitat is obtained further survey work will need to be conducted. Specifically, further surveys for bats and further spotlighting for nocturnal fauna will be required. In addition to the above, another survey of the same area should be conducted during the winter/autumn months in an effort to identify migratory species which may not be present in Goonoo State Forest during the spring/summer months. Heron (1973) concluded that it is evident that seasonal conditions have a great effect on the bird life in the Goonoo State Forest with some migrants arriving in large numbers in good years.

Until such surveys are undertaken the results of the fauna survey of Compartment 55-2 provide a representative sample of the fauna associated with cypress pine-ironbark forests in Central-West New South Wales and will assist in the future management and planning of Goonoo State Forest.

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